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I, SMILJA DRAGOSAVLJEVIC, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PS 3320 for a patent by GANENDRA COOMER BOSE as filed on 03 July 2002.

I further certify that the above application is now proceeding in the name of UCL BIOMEDICA PLC pursuant to the provisions of Section 113 of the Patents Act 1990.

COMMONWEALTH OF AUSTRALIA
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WITNESS my hand this
Third day of September 2003

S. Dragosavljevic

SMILJA DRAGOSAVLJEVIC
TEAM LEADER EXAMINATION
SUPPORT AND SALES

APPLICANT: ~~GANENDRA COOMER BOSE~~ UCL Biomedica PLC

NUMBER:

FILED:

AUSTRALIA

THE PATENTS ACT 1990

PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED

"LAPAROSCOPIC NEEDLE DELIVERY DEVICE AND SUTURING TECHNIQUE"

The present invention will be described in the following statement:

TITLE

LAPAROSCOPIC NEEDLE DELIVERY DEVICE AND SUTURING TECHNIQUE

FIELD OF THE INVENTION

The present invention relates to a laparoscopic needle delivery device, a laparoscopic suturing device, and suturing technique using said devices.

BACKGROUND OF THE INVENTION

Laparoscopic suturing and knot tying is widely recognised as technically difficult. It takes a considerable amount of practice to master the technique and unless a surgeon has had enough practice in performing laparoscopic suturing regularly, the surgeon cannot do it easily or in a timely fashion during the operation.

In particular, it is difficult to deliver a curved needle for laparoscopic intracorporeal suturing in a desirable position such that it can be held and manipulated. Further, the tying of intracorporeal knots can be extremely difficult and time consuming.

There are several special instruments and techniques, both automatic and semi-automatic, which have been developed for laparoscopic suturing over the years. Although many of them are technically superb, their use is cost prohibitive and limited to the private health system.

The present invention attempts to overcome at least in part some of the aforementioned disadvantages.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention there is provided a laparoscopic needle delivery device comprising a tubular rod having a central lumen for receiving a length of suture, a first receiving means for receiving a needle, and a second receiving means for receiving at least one loop of suture.

In accordance with a second aspect of the present invention there is provided a laparoscopic suturing device for ligating blood vessels comprising an elongate member having a hooked distal end for receiving a length of blood vessel, an aperture disposed in the hooked distal end for receiving a length of suture, and a receiving means for receiving at least one loop of suture.

DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic perspective view of a laparoscopic needle delivery device in accordance with a first aspect of the present invention;

Figure 2 is a diagrammatic perspective view of the device shown in Figure 1 wherein a needle, previously received by the device, is grasped and removed by a grasping device;

Figure 3 is a diagrammatic perspective view of the device shown in Figures 1 and 2 wherein the needle has been passed through cut edges of a viscera by the grasping device and is shown being pulled through a pair of loops of suture, previously received by the device, by the grasping device in order to form a knot;

Figures 4 to 13 are schematic views of successive steps in forming and tying several intracorporeal knots with the aid of the laparoscopic needle delivery device of the present invention; and

Figure 14 is a diagrammatic view of a laparoscopic suturing device for ligating blood vessels or tubular structures in accordance with a second aspect of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the Figures, wherein like numerals and symbols refer to like parts throughout, there is shown a laparoscopic needle delivery device 10. The laparoscopic needle delivery device 10 includes a tubular rod 12 having a central lumen 14 for receiving a length of suture 20, a first receiving means 16 for receiving a curved needle 30, and a second receiving means 18 for receiving at least one loop 22 of suture 20.

The tubular rod 12 has a tapered distal end 11, and is formed from either a rigid plastics material or a biocompatible metallic material of approximately 5 mm diameter. In use, the rod 12 may be mounted adjacent to and in longitudinal alignment with a shaft of a grasping means, such as a set of straight or curved forceps or grasper, by a suitable attachment means such as windings of tape, a clip or similar mounting means. The tubular rod 12 can also be provided with a telescopic attachment by which the distal end 11 can be longitudinally translated and retracted when required.

In the case of a right handed surgeon, the laparoscopic needle delivery device 10 would be introduced concurrently with the shaft of the grasping means through a port disposed on a left hand side of a surgical site, whereas in the case of a left handed surgeon, the laparoscopic needle delivery device 10 would be introduced concurrently with the shaft of the grasping means through a port disposed on a right hand side of a surgical site.

A diameter of the central lumen 14 is chosen so as to readily receive the length of suture 20 as shown in Figure 1. A distal end 24 of the suture 20 is endwise attached by conventional means to the needle 30, preferably to a curved needle 30.

The first receiving means 16 for receiving the needle 30 includes a pair of adjacent notches 17a, 17b that extend into the central lumen 14. In use, a free end 32 of the curved needle 30 is received in the notch 17a, then fed into the central lumen 14 until the free end 32 emerges from the adjacent notch 17b, as shown in Figure 1. In this way, the needle 30 may be held in a desirable and stable arrangement on the laparoscopic needle delivery device 10 when it is introduced through the port. A second set of forceps or a grasping means, held and manipulated by the alternative hand of the surgeon, may then be used to unhook the needle 30 from the laparoscopic needle delivery device 10 and commence suturing, as shown in Figure 2.

Alternatively, the first receiving means 16 may comprise a clip for receiving the curved needle 30 mounted on the tubular rod 12. Still further, the first receiving means 16 may comprise a tubular structure for receiving the needle 30 mounted longitudinally alongside the tubular rod 12.

The second receiving means 18 for receiving at least one loop 22 of suture 20 includes a protruding member 19 extending substantially alongside the rod 12 such that a small gap is provided between the rod 12 and the protruding member 19 for receiving at least one loop 22 of suture 20. The protruding member 19 may take the form of a notch in the rod 12. Alternatively, the protruding member 19 may be formed to be retractable. In any case, the loop 22 of suture 20 may be held in a desirable and stable arrangement on the laparoscopic needle delivery device 10 when it is introduced through the port. A second set of forceps or a grasping means held and manipulated by the alternative hand of the surgeon may then be used to unhook the loop 22 from the laparoscopic needle delivery device 10. The grasping means may then be used to grasp the needle 30 which has already passed through cut edges

of a viscera or structure and pulled through the loop 22. The loop 22 can now be released from the second receiving means 18 or alternatively is released by tensioning both ends of the suture thereby forming a double knot to secure the suturing, as shown in Figure 3.

Preferably, a pair of loops 22 of suture is received in the second receiving means 18 to form a double knot. Still more preferably, the pair of loops 22 is formed according to the following description as shown in Figures 4 to 8.

Referring to Figure 4, two loops resembling a figure of eight shape are formed extracorporeally, wherein a first loop 220 is formed proximal the distal end 24 of the suture 20 attached to the needle 30 and a second loop 230, extending in an opposing direction to the first loop 220, is formed proximal to the first loop 22. The distal end 24 of the suture 20 is arranged to be disposed anterior to a vertical limb 215 of the figure of eight shape, as is a proximal end 26 of the suture 20.

The second loop 230 is then inverted so as to be adjacent and in parallel alignment with the first loop 220 so that the distal end 24 of the suture 20 is disposed intermediate the first and second loops 220, 230, as shown in Figure 5. It is envisaged that the pair of loops 220, 230 may then be received in the second receiving means 18 of the laparoscopic needle delivery device 10 by means of a grasping tool and introduced intracorporeally as described above. Once the distal end 24 has passed through the loops 220, 230, the loops 220, 230 can then be readily disengaged from the second receiving means 18 by a releasing mechanism or an appropriate grasping tool, or by pulling respective suture ends 24, 26.

It will be understood that the pair of loops 220, 230 described above may also be introduced intracorporeally through the port with a conventional grasping tool.

After intracorporeal suturing has been completed, the needle 30 carrying the distal end 24 of the suture, after passing through cut edges of the viscera, may be pulled through the pair of loops 220, 230. The distal and proximal ends 24, 26 of the suture 20 can thus be pulled simultaneous by grasping tools, thereby allowi□äng loops 220, 230 to form a double knot to sece the suturing, as shown in Figure 8. Further securing with additional knots can then be formed in the conventional fashion.

The laparoscopic needle delivery device 10 of the present invention can be advantageously and readily used in the intracorporeal formation of further loops for securing the suture knot formed on the viscera. Referring to Figures 9 to 11, the laparoscopic needle delivery device 10 can be forwardly translated in relation to the viscera to form a half loop 21. A curved needle holder 50 or similar grasping tool is placed inside the half loop from the right hand side of the loop 21, as shown in Figure 10. The needle delivery device 10 is retracted to form a complete loop and the needle holder 50 is caused to grasp the distal end 24 of the suture 20. The needle holder 50 is then withdrawn through the loop 23 so formed, so pulling the distal end 24 of the suture 20 back through the loop 23 to form another knot, as shown in Figure 11. The knot so formed is executed by the surgeon with merely a simple backwards and forwards motion of the laparoscopic needle delivery device 10 and the grasping tool held in the opposing hand. No rotational movement, which is a difficult technique to perform, is required.

An intracorporeal loop 22 and subsequent knot may also be conveniently made and tied by rotating the laparoscopic needle delivery device 10. Referring to Figures 12 and 13, a reverse loop 25 can be formed by disposing the tubular rod 12 of the device 10 anterior to the suture 20, then rotating the tubular rod 12 in a clockwise direction

whilst simultaneously forwardly translating the tubular rod 12. The grasping tool 50 is passed from the left hand side of the tubular rod 12 into the reverse loop 25 so formed and caused to grasp the distal end 24 of the suture 20. The grasping tool 50 is then withdrawn through the reverse loop 25, so pulling the distal end 24 of the suture 20 back through the reverse loop 25 to form a reverse knot, as shown in Figure 13. In this way, two additional knots over an original double knot should make the knot very secure.

It is envisaged that the loops of a "surgeon's knot" may also be formed extracorporeally, whereupon the loops may be received in the second receiving means 18 of the laparoscopic needle delivery device 10, delivered through the port to the area of interest and secured according to conventional means.

Referring to Figure 14 there is shown a laparoscopic suturing device 110 for ligating blood vessels. The laparoscopic suturing device 110 includes an elongate member 112 having a hooked distal end 114 for receiving a length of blood vessel 130, an aperture 116 disposed in the hooked distal end 114 for receiving a length of suture 20, and a receiving means 118 for receiving at least one loop of suture 22. The device 110 also includes a hinged grasping means 113 comprised of two hinged jaws that can be opened or shut by pressing or releasing an operative extracorporeal handle.

The elongate member 112 is formed from either a rigid plastics material or a biocompatible metallic material of approximately 5 mm diameter. In the case of a right handed surgeon, the laparoscopic suturing device 110 would be introduced through a port disposed on a left hand side of a surgical site, whereas in the case of a left handed surgeon, the laparoscopic suturing device 110 would be introduced through a port disposed on a right hand side of a surgical site.

A diameter of the aperture 116 is chosen so as to readily receive the length of suture 20 as shown in Figure 14. It is envisaged that the aperture 116 is formed from opposing semicircular recesses disposed in each jaw of the grasping means 113, wherein the recesses are disposed adjacent the hinge of the jaws.

The receiving means 118 for receiving at least one loop 22 of suture 20 includes a protruding member 119 extending substantially alongside the elongate member 112 such that a small gap is provided between the elongate member 112 and the protruding member 119 for receiving at least one loop 22 of suture 20. The protruding member 119 may take the form of a notch in the rod 12. Alternatively, the protruding member 119 may be formed to be retractable. In any case, the loop 22 of suture 20 may be held in a desirable and stable arrangement on the laparoscopic suturing device 110 when it is introduced through the port. A second set of forceps or a grasping means held and manipulated by the alternative hand of the surgeon may then be used to unhook the loop 22 from the laparoscopic suturing device 10.

In use, a length of blood vessel 130 is received in the hooked distal end 114 whereupon the suture end 24 may be pulled through the loop 22 which will be detached from the receiving means 118 of the laparoscopic suturing device 110, thereby forming a knot to ligate the blood vessel 130, as shown in Figure 14. Additional knots can be tied as described with reference to Figures 9, 10, 11, 12 and 13. After the suture 20 has been cut, the hooked distal end 114 may disengage with the length of blood vessel 130. In this way, ligation of blood vessels 130 may be conveniently performed in a very simple action.

Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention

DATED THIS 3RD DAY OF JULY 2002.

~~GANENDRA COOMER BOSE~~ UCL Biomedica PLC

By his Patent Attorneys
LORD & COMPANY
PERTH, WESTERN AUSTRALIA.

AUSTRALIAN PATENT OFFICE SEC 113

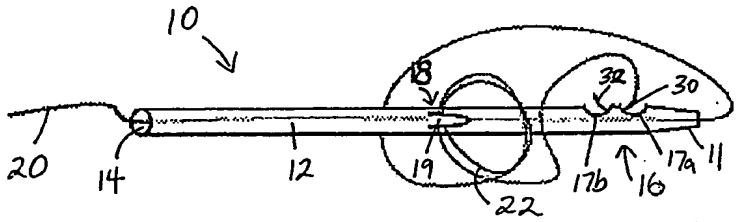

Figure 1

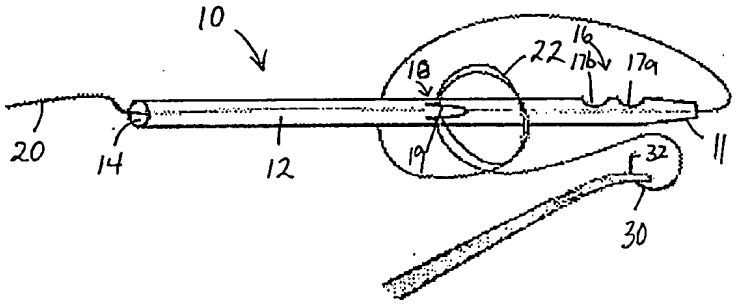

Figure 2

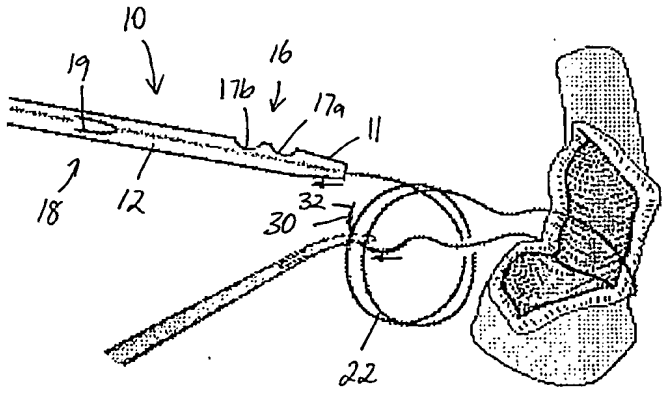

Figure 3

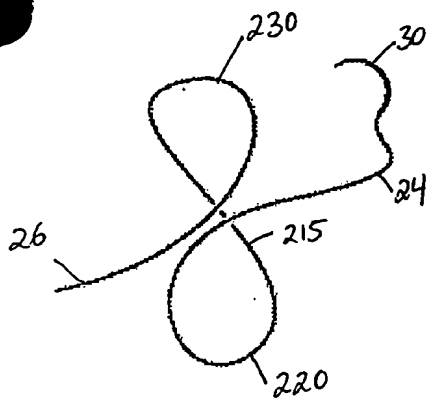

Figure 4

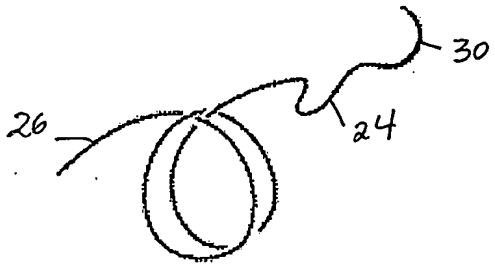

Figure 5

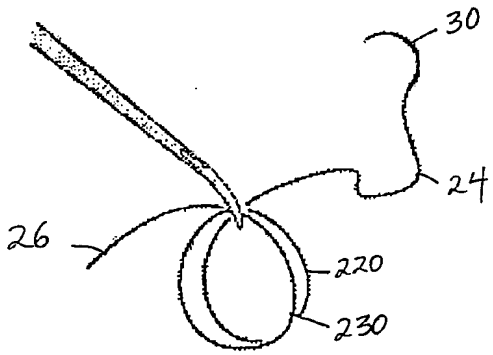

Figure 6

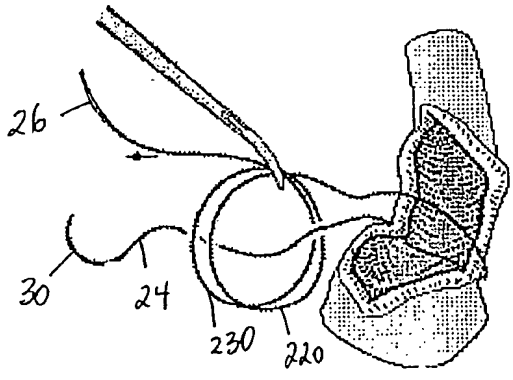

Figure 7

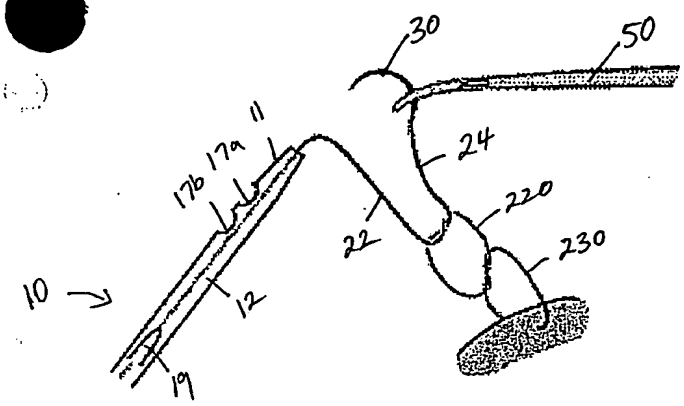

Figure 8

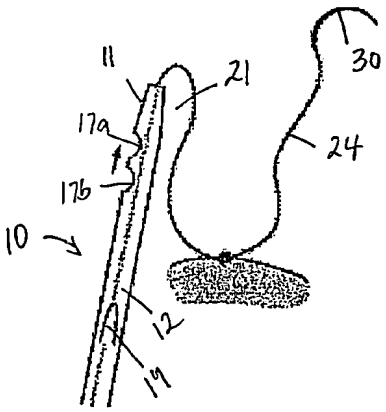

Figure 9

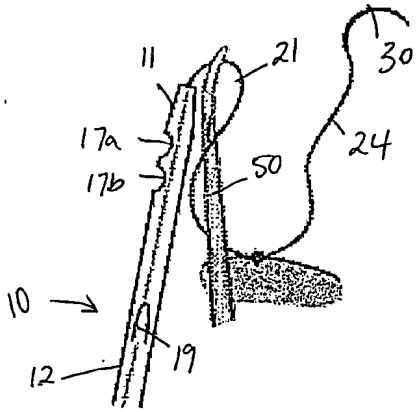

Figure 10

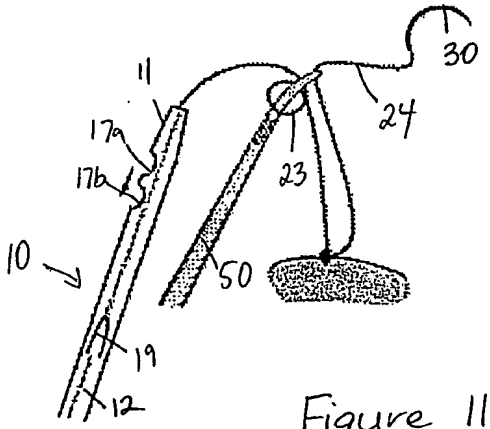

Figure 11

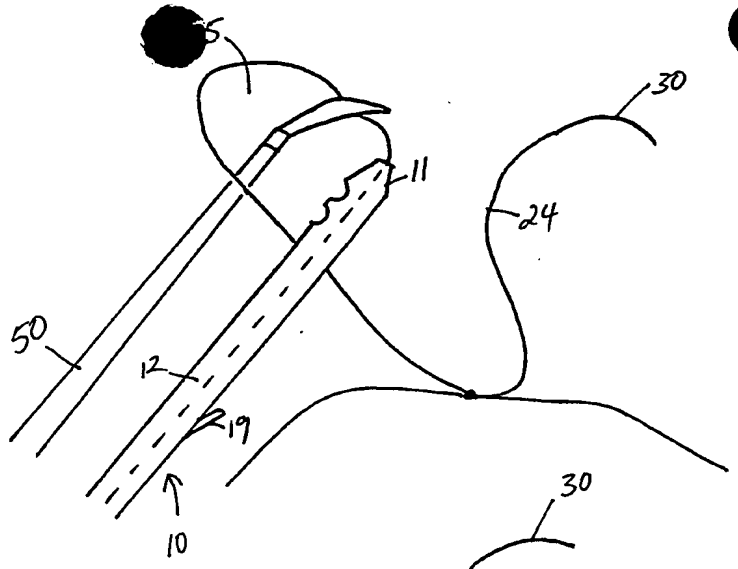

Figure 12

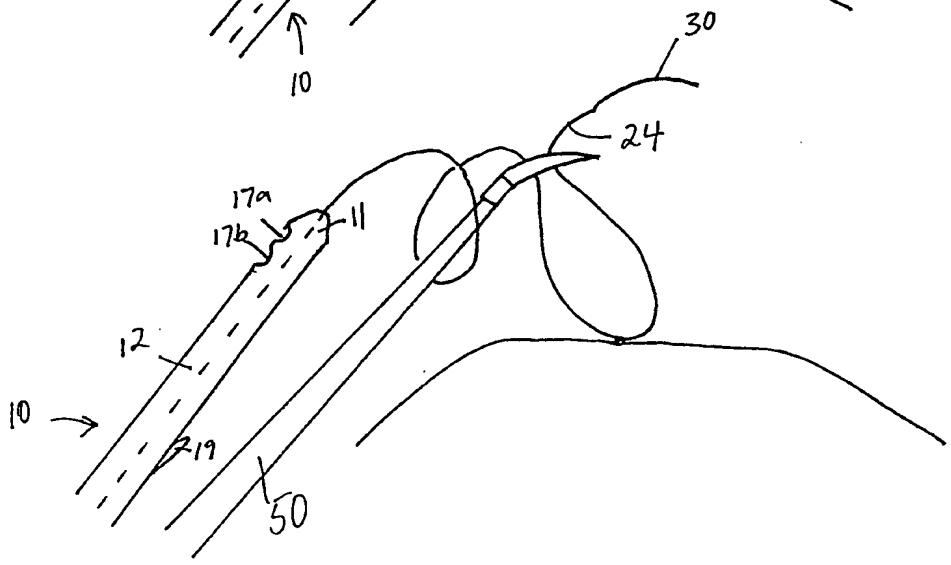

Figure 13

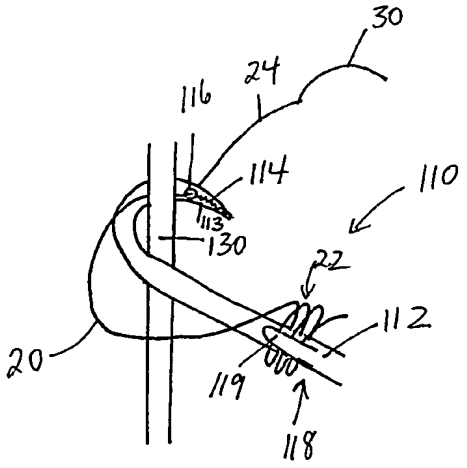

Figure 14

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I, SMILJA DRAGOSAVLJEVIC, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952166 for a patent by GANENDRA COOMER BOSE as filed on 21 October 2002.

I further certify that the above application is now proceeding in the name of UCL BIOMEDICA PLC pursuant to the provisions of Section 113 of the Patents Act 1990.

WITNESS my hand this
Third day of September 2003

S. Dragosavljevic

SMILJA DRAGOSAVLJEVIC
TEAM LEADER EXAMINATION
SUPPORT AND SALES

APPLICANT: GANENDRA COOMER BOSE

NUMBER:

FILED:

AUSTRALIA

THE PATENTS ACT 1990

PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED

"LAPAROSCOPIC NEEDLE DELIVERY DEVICE AND SUTURING TECHNIQUE"

The present invention will be described in the following statement:

TITLE

LAPAROSCOPIC NEEDLE DELIVERY DEVICE AND SUTURING TECHNIQUE

FIELD OF THE INVENTION

The present invention relates to a laparoscopic needle delivery device, a laparoscopic suturing device, and suturing technique using said devices.

BACKGROUND OF THE INVENTION

Laparoscopic suturing and knot tying is widely recognised as technically difficult. It takes a considerable amount of practice to master the technique and unless a surgeon has had enough practice in performing laparoscopic suturing regularly, the surgeon cannot do it easily or in a timely fashion during the operation.

In particular, it is difficult to deliver a curved needle for laparoscopic intracorporeal suturing in a desirable position such that it can be held and manipulated. Further, the tying of intracorporeal knots can be extremely difficult and time consuming.

There are several special instruments and techniques, both automatic and semi-automatic, which have been developed for laparoscopic suturing over the years. Although many of them are technically superb, their use is cost prohibitive and limited to the private health system.

The present invention attempts to overcome at least in part some of the aforementioned disadvantages.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention there is provided a laparoscopic needle delivery device comprising a tubular rod having a central lumen for receiving a length of suture, a first receiving means for receiving a needle, and a second receiving means for receiving at least one loop of suture.

In accordance with a second aspect of the present invention there is provided a laparoscopic suturing device for ligating blood vessels comprising an elongate member having a hooked distal end for receiving a length of blood vessel, an aperture disposed in the hooked distal end for receiving a length of suture, and a receiving means for receiving at least one loop of suture.

DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic perspective view of a laparoscopic needle delivery device in accordance with a first aspect of the present invention;

Figure 2 is a diagrammatic perspective view of the device shown in Figure 1 wherein a needle, previously received by the device, is grasped and removed by a grasping device, and or a needle holder;

Figure 3 is a diagrammatic perspective view of the device shown in Figures 1 and 2 wherein the needle has been passed through cut edges of a viscera by the grasping device and is shown being pulled through a pair of loops of suture, previously received by the device, by the grasping device in order to form a knot;

Figures 4 to 17 are schematic views of successive steps in forming and tying several intracorporeal knots with the aid of a similar kind of device as the laparoscopic needle delivery device of the present invention without a needle receiving means; and

Figure 18 is a diagrammatic view of a laparoscopic suturing device for ligating blood vessels or tubular structures in accordance with a second aspect of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the Figures, wherein like numerals and symbols refer to like parts throughout, there is shown a laparoscopic needle delivery device 10. The laparoscopic needle delivery device 10 includes a tubular rod 12 having a central lumen 14 for receiving a length of suture 20, a first receiving means 16 for receiving a curved needle 30, and a second receiving means 18 for receiving at least one loop 22 of suture 20.

The tubular rod 12 has a tapered distal end 11, and is formed from either a rigid plastics material or a biocompatible metallic material of approximately 5 mm diameter. In use, the rod 12 may be mounted adjacent to and in longitudinal alignment with a shaft of a grasping means, such as a set of straight or curved forceps or grasper, by a suitable attachment means such as windings of tape, a clip or similar mounting means. The tubular rod 12 can also be provided with a telescopic attachment by which the distal end 11 can be longitudinally translated and retracted when required.

In the case of a right handed surgeon, the laparoscopic needle delivery device 10 would be introduced concurrently with the shaft of the grasping means through a port disposed on a left hand side of a surgical site, whereas in the case of a left handed surgeon, the laparoscopic needle delivery device 10 would be introduced concurrently with the shaft of the grasping means through a port disposed on a right hand side of a surgical site.

A diameter of the central lumen 14 is chosen so as to readily receive the length of suture 20 as shown in Figure 1. A distal end 24 of the suture 20 is endwise attached by conventional means to the needle 30, preferably to a curved needle 30.

The first receiving means 16 for receiving the needle 30 includes a pair of adjacent notches 17a, 17b that extend into the central lumen 14. In use, a free end 32 of the curved needle 30 is received in the notch 17a, then fed into the central lumen 14 until the free end 32 emerges from the adjacent notch 17b, as shown in Figure 1. In this way, the needle 30 may be held in a desirable and stable arrangement on the laparoscopic needle delivery device 10 when it is introduced through the port. A second set of forceps or a grasping means, held and manipulated by the alternative hand of the surgeon, may then be used to unhook the needle 30 from the laparoscopic needle delivery device 10 and commence suturing, as shown in Figure 2.

Alternatively, the first receiving means 16 may comprise a clip for receiving the curved needle 30 mounted on the tubular rod 12. Still further, the first receiving means 16 may comprise a tubular structure for receiving the needle 30 mounted longitudinally alongside the tubular rod 12.

Still yet further, the tubular rod 12 may be formed from a soft piercable plastics material. The needle 30 may then be manipulated to pierce the tubular rod 12 so as to hook itself to the tubular rod 12, and thus secure itself.

The second receiving means 18 for receiving at least one loop 22 of suture 20 includes a protruding member 19 extending substantially alongside the rod 12 such that a small gap is provided between the rod 12 and the protruding member 19 for receiving at least one loop 22 of suture 20. The protruding member 19 may take the form of a notch in the rod 12. Alternatively, the protruding member 19 may be formed to be retractable. In any case, the loop 22 of suture 20 may be held in a desirable and stable arrangement on the laparoscopic needle delivery device 10 when it is introduced through the port. A second set of forceps or a grasping means held

and manipulated by the alternative hand of the surgeon may then be used to unhook the loop 22 from the laparoscopic needle delivery device 10. The grasping means may then be used to grasp the needle 30 which has already passed through cut edges of a viscera or structure and pulled through the loop 22. The loop 22 can now be released from the second receiving means 18 or alternatively is released by tensioning both ends of the suture thereby forming a double knot to secure the suturing, as shown in Figure 3.

Preferably, a pair of loops 22 of suture is received in the second receiving means 18 to form a double knot. Still more preferably, the pair of loops 22 is formed according to the following description as shown in Figures 4 to 8.

Referring to Figure 4, two loops resembling a figure of eight shape are formed extracorporeally, wherein a first loop 220 is formed proximal the distal end 24 of the suture 20 attached to the needle 30 and a second loop 230, extending in an opposing direction to the first loop 220, is formed proximal to the first loop 22. The distal end 24 of the suture 20 is arranged to be disposed anterior to a vertical limb 215 of the figure of eight shape, as is a proximal end 26 of the suture 20.

The second loop 230 is then inverted so as to be adjacent and in parallel alignment with the first loop 220 so that the distal end 24, as well as the proximal end 26, of the suture 20 is disposed intermediate the first and second loops 220, 230, as shown in Figure 5. It is envisaged that the pair of loops 220, 230 may then be received in the second receiving means 18 of the laparoscopic needle delivery device 10 by means of a grasping tool and introduced intracorporeally as described above. Once the distal end 24 has passed through the loops 220, 230, the loops 220, 230 can then be readily

disengaged from the second receiving means 18 by a releasing mechanism or an appropriate grasping tool, or by pulling respective suture ends 24, 26.

Alternatively, the loops 220 and 230 can be kept fixed temporarily by using a conventional biocompatible biodegradable glue. This is particularly suitable for sutures formed from synthetic suture materials, such as polyglycolic acid. The loops 220 and 230 may be preformed before insertion into the port, wherein the loops 220 and 230 are "weakly glued" together by the desired adhesive.

It will be understood that the pair of loops 220, 230 described above may also be introduced intracorporeally through the port with a conventional grasping tool.

After intracorporeal suturing has been completed, the needle 30 carrying the distal end 24 of the suture, after passing through cut edges of the viscera, may be pulled through the pair of loops 220, 230 as shown in Figure 7. The distal and proximal ends 24, 26 of the suture 20 can thus be pulled simultaneously by grasping tools, thereby allowing loops 220, 230 to form a double knot to secure the suturing, as shown in Figure 8. Further securing with additional knots can then be formed in the conventional fashion.

Alternatively, the pair of loops 220, 230 may be threaded over a terminal end of a cut blood vessel or tubal structure, such that the terminal end of the blood vessel or tubal structure extends through the loops 220, 230 as shown in Figure 9. The distal and proximal ends 24, 26 of the suture 20 can then be pulled simultaneously by grasping tools, thereby tightening loops 220, 230 and affording ligation of the terminal end of the blood vessel or tubal structure, as shown in Figure 10. Further securing with additional knots can then be formed in the conventional fashion.

Ligation of a continual blood vessel or tube may also be achieved by positioning the pair of loops 220, 230m anterior of the blood vessel or tube, and passing the proximal end 26 of the suture 20 over the blood vessel or tube to its posterior side, and then passing the proximal end 26 of the suture 20 underneath the blood vessel or tube and through the pair of loops 220, 230, as shown in Figures 11a and 11b. The distal and proximal ends 24, 26 of the suture 20 can then be pulled simultaneously by grasping tools, thereby tightening loops 220, 230, as shown in Figure 12. Further securing with additional knots can then be formed in the conventional fashion.

The inventor of the present invention has found that it is advantageous to provide the distal end 24 of the suture 20 with a small weight, such that when the distal end 24 is passed over the blood vessel or tube to its posterior side, the weight falls under its weight to a relatively lower position. It is found that the distal end 24 of the suture 20 is thus conveniently disposed underneath the blood vessel or tube and may then be merely grasped and pulled through the pair of loops 220, 230, without any requirement for further manipulation, thus saving time during the suturing process.

It is envisaged that the weight may be tear-drop shaped and formed from a metallic material, or other dense rigid material that is readily sterilised, or alternatively, a biodegradable material.

The laparoscopic needle delivery device 10 of the present invention can be advantageously and readily used in the intracorporeal formation of further loops for securing the suture knot formed on the viscera or tubular structure. Referring to Figures 13 to 15, the laparoscopic needle delivery device 10 can be forwardly translated in relation to the viscera to form a half loop 21. A curved needle holder 50 or similar grasping tool is placed inside the half loop from the right hand side of the

loop 21, as shown in Figure 14. The needle delivery device 10 is retracted to form a complete loop and the needle holder 50 is caused to grasp the distal end 24 of the suture 20. The needle holder 50 is then withdrawn through the loop 23 so formed, so pulling the distal end 24 of the suture 20 back through the loop 23 to form another knot, as shown in Figure 15. The knot so formed is executed by the surgeon with merely a simple backwards and forwards motion of the laparoscopic needle delivery device 10 and the grasping tool held in the opposing hand. No rotational movement, which is a difficult technique to perform intracorporeally, is required.

An intracorporeal loop 22 and subsequent knot may also be conveniently made and tied by rotating the laparoscopic needle delivery device 10 or grasping forceps to hold the reverse loop 25. Referring to Figures 16 and 17, a reverse loop 25 can be formed by disposing the tubular rod 12 of the device 10 anterior to the suture 20, then rotating the tubular rod 12 in a clockwise direction whilst simultaneously forwardly translating the tubular rod 12. The grasping tool 50 is passed from the left hand side of the tubular rod 12 into the reverse loop 25 so formed and caused to grasp the distal end 24 of the suture 20. The grasping tool 50 is then withdrawn through the reverse loop 25, so pulling the distal end 24 of the suture 20 back through the reverse loop 25 to form a reverse knot, as shown in Figure 17. In this way, two additional knots over an original double knot should make the knot very secure.

It is envisaged that the loops of a "surgeon's knot" may also be formed extracorporeally, whereupon the loops may be received in the second receiving means 18 of the laparoscopic needle delivery device 10, delivered through the port to the area of interest and secured according to conventional means.

Referring to Figure 18 there is shown a laparoscopic suturing device 110 for ligating blood vessels or tubular structures. The laparoscopic suturing device 110 includes an elongate member 112 having a hooked distal end 114 for receiving a length of blood vessel 130, an aperture 116 disposed in the hooked distal end 114 for receiving a length of suture 20, and a receiving means 118 for receiving at least one loop of suture 22. The device 110 also includes a hinged grasping means 113 comprised of two hinged jaws that can be opened or shut by pressing or releasing an operative extracorporeal handle.

The elongate member 112 is formed from either a rigid plastics material or a biocompatible metallic material of approximately 5 mm diameter. In the case of a right handed surgeon, the laparoscopic suturing device 110 would be introduced through a port disposed on a left hand side of a surgical site, whereas in the case of a left handed surgeon, the laparoscopic suturing device 110 would be introduced through a port disposed on a right hand side of a surgical site.

A diameter of the aperture 116 is chosen so as to readily receive the length of suture 20 as shown in Figure 18. It is envisaged that the aperture 116 is formed from opposing semicircular recesses disposed in each jaw of the grasping means 113, wherein the recesses are disposed adjacent the hinge of the jaws.

The receiving means 118 for receiving at least one loop 22 of suture 20 includes a protruding member 119 extending substantially alongside the elongate member 112 such that a small gap is provided between the elongate member 112 and the protruding member 119 for receiving at least one loop 22 of suture 20. The protruding member 119 may take the form of a notch in the rod 12. Alternatively, the protruding member 119 may be formed to be retractable. In any case, the loop 22 of

suture 20 may be held in a desirable and stable arrangement on the laparoscopic suturing device 110 when it is introduced through the port. A second set of forceps or a grasping means held and manipulated by the alternative hand of the surgeon may then be used to unhook the loop 22 from the laparoscopic suturing device 10.

In use, a length of blood vessel 130 is received in the hooked distal end 114 whereupon the suture end 24 may be pulled through the loop 22 which will be detached from the receiving means 118 of the laparoscopic suturing device 110, thereby forming a knot to ligate the blood vessel 130, as shown in Figure 18. Additional knots can be tied as described with reference to Figures 13, 14, 15, 16 and 17. After the suture 20 has been cut, the hooked distal end 114 may disengage with the length of blood vessel 130. In this way, ligation of blood vessels 130 may be conveniently performed in a very simple action.

Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention.

DATED THIS 21ST DAY OF OCTOBER 2002.

GANENDRA COOMER BOSE
By his Patent Attorneys
LORD & COMPANY
PERTH, WESTERN AUSTRALIA.

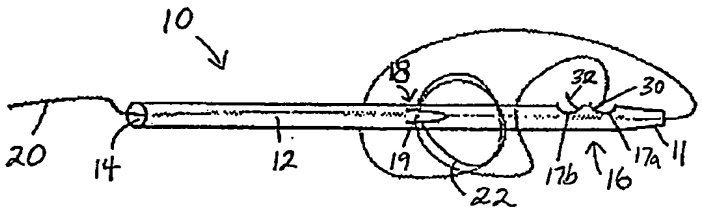


Figure 1

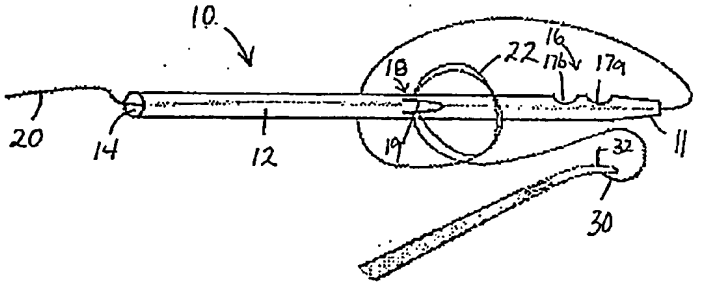
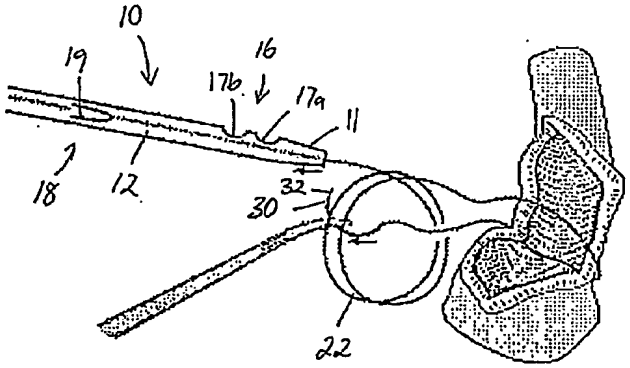


Figure 2



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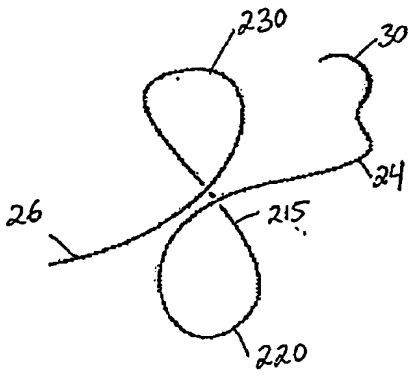


Figure 4

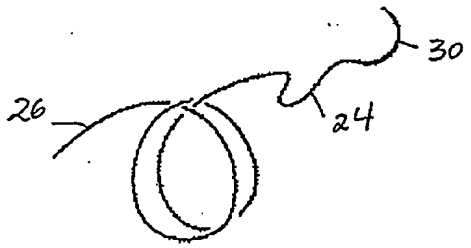
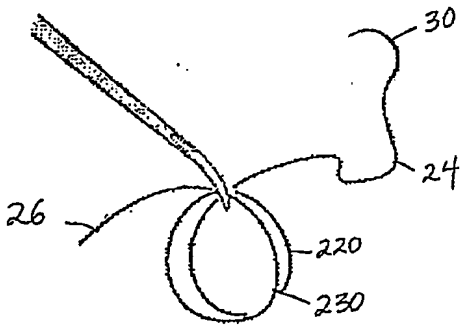


Figure 5



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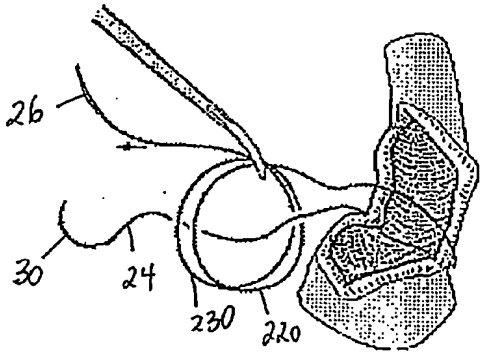

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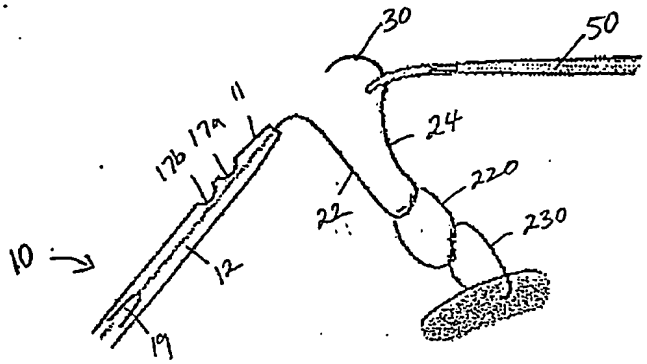


Figure 8

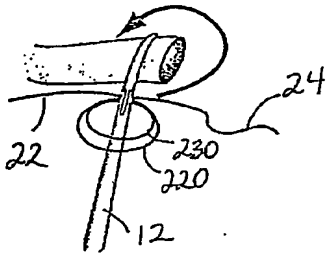


Figure 9

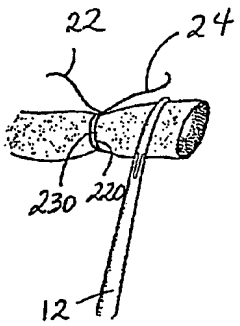


Figure 10

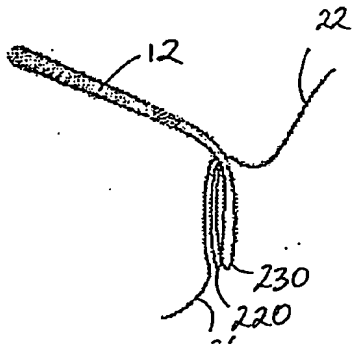


Figure 11a

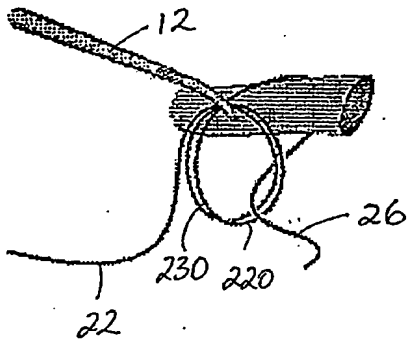


Figure 11b

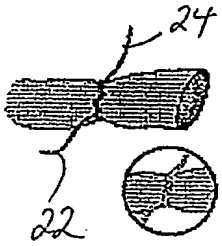


Figure 12

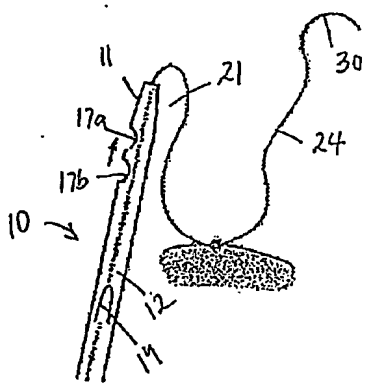


Figure 13

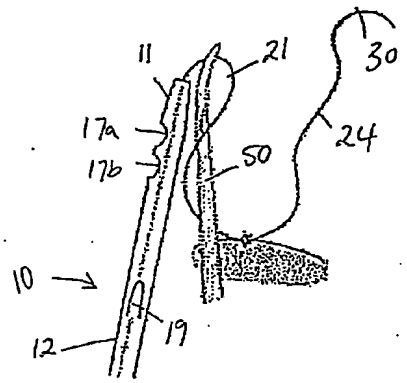
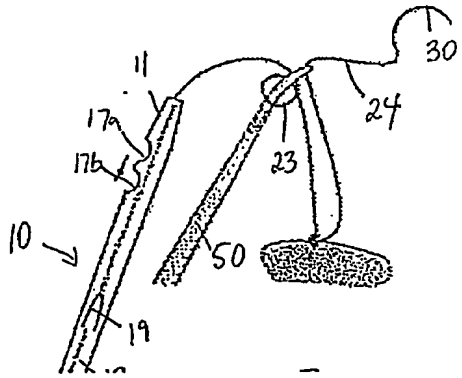


Figure 14



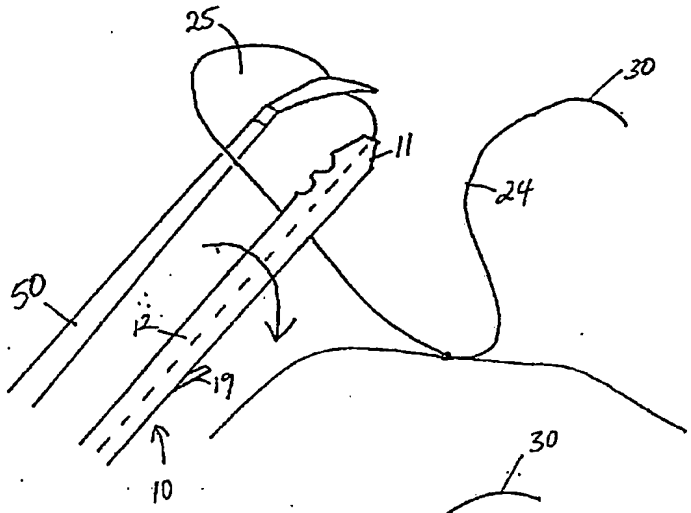


Figure 16

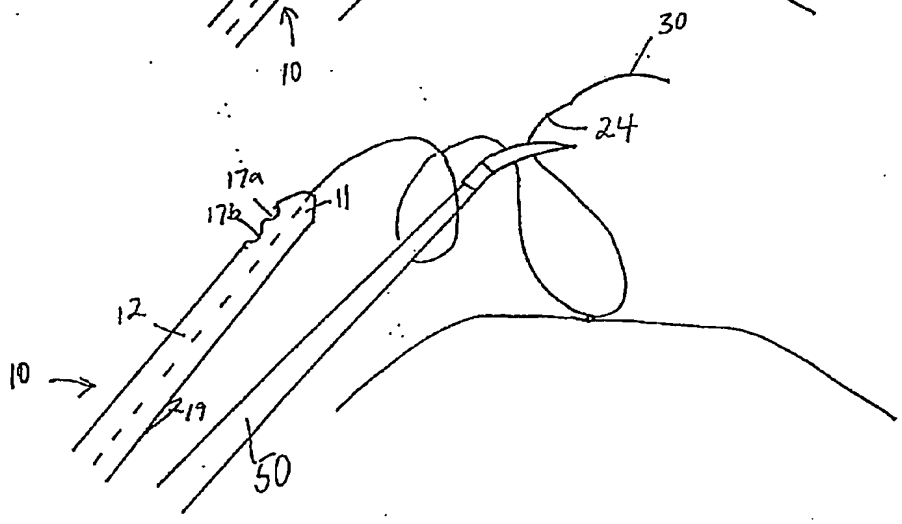


Figure 17

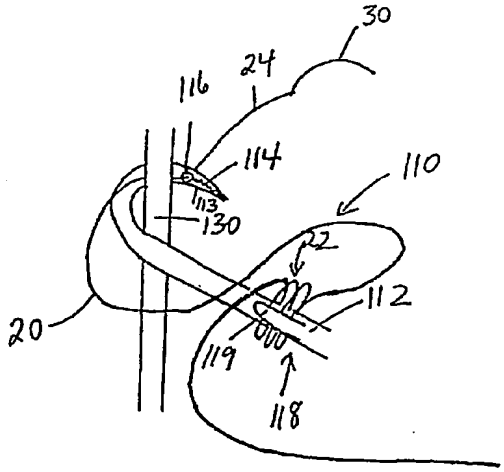


Figure 18